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SEAT OF A MOTOR VEHICLE AND SPRING SYSTEM THEREFOR

The invention relates to a seat of a motor vehicle, the cushion of which is provided with springing, and to springing for such a seat.

Car seats of motor vehicles conventionally have a seat cushion which is provided with a spring underneath the cushion top which forms the surface of the seat. This spring, also called the under-spring, consists as a rule of one or more meander-shaped spring wires arranged parallel to one another, which are fastened to a frame or to the seat pad. It is a disadvantage that, on account of different body weights, stature, body structure and feelings of each user of the motor vehicle, different requirements are the result with regard to comfort, that is, the springing of the car seat. Accordingly, the under-spring of seat pads of conventional car seats is only a compromise and is optimally adapted only to one specific type of person as regards damping, isolation, resonance and stiffness. For good comfort it would accordingly be necessary to adapt the car seat specifically to a particular driver or user of the vehicle, especially as regards the stiffness of the springs of the seat cushion.

Furthermore, in the field of utility vehicles, and especially in the field of omnibuses, it is known to equip the driver's seat with adjustable springing based on gas spring dampers. In this way the under-spring of the seat can be adjusted optimally in each case to the – as a rule – professional bus driver, i.e., it can be varied as to its stiffness. It is disadvantageous in this case that such springing of a vehicle seat is complex in design and calls for a certain amount of space, especially as regards height, in order to be able to provide the spring damper underneath the seat cushion.

It is accordingly the problem of the present invention to offer underspringing for the seat cushion, as well as such springing for a seat of a motor vehicle, which, in regard to comfort and seat hardness, can be optimally adapted to different persons and/or riding situations, without requiring devices of complex design.

This problem is solved by a seat for a motor vehicle according to the characteristics of claim 1 as well as by springing for a motor vehicle seat according to the characteristics of claim 11. Advantageous configurations and improvements are subject matter of the sub-claims.

According to the invention the seat for a motor vehicle has a seat cushion which is provided with an underspring system which has a plurality of mechanical springs, the springs being arranged substantially in a horizontal plane in or under the seat pad, and held at their ends on a support, means being provided for the adjustment of the stiffness of the springs. In this way the stiffness of the underspring of the seat cushion can be advantageously varied. Adjustment of the spring stiffness is advantageous on the one hand because the seat can thereby be optimally adapted to different persons of different body structure and body weight, and on the other hand because an adjustment of the spring stiffness can be adapted in each case according to the driving situation or driving style. Due to the possibility of adjusting the spring stiffness of the vehicle's seat, any "bottoming out" of the seat, such as happens due to the sagging of the springs after long use, especially in older vehicles, can be effectively prevented. Last, but not least, due to the possibility of adjusting the spring stiffness, a dynamic variation of the seat hardness by periodical replacement or adjustment of the stiffness of one or more springs is possible, as well as the implementation of other orthopedic functions, such as an asymmetrical adjustment of different springs of the underspring of the seat. An adjustment of the stiffness of the springing of a seat is also advantageous in various driving situations or driving styles, as for example off-road driving, sport driving, cornering or driving on bad road surfaces. Also, the comfort of every person is different and, for an optimum in seating comfort, it requires that the stiffness of the car seat be best adapted in each case, since the shock absorption and resonant frequencies of each person are different. The invention thus offers, in a simple design of the seats of vehicles with mechanical springing, an optimum adaptation of the seat stiffness for a definite gain in comfort, in comparison to the vehicle seats known heretofore, which always represent a compromise regarding the hardness or softness of the springing in the seat pads of vehicle seats.

In one advantageous embodiment of the invention, each spring is provided with a separate device for adjusting its stiffness. In this way a different spring stiffness can be set in different areas of the seat cushion; for example stiffer springing in the middle than in the side areas. Thus the comfort and optimum adjustment of the stiffness of the car seat can be further enhanced, and user-specific stiffness patterns can be produced in a great range of variation. Stiffer springing in the middle of the seat cushion is advantageous, for example, for better support of the spinal region of slipped disk sufferers.

In another advantageous embodiment of the invention, the means for adjusting spring stiffness are constructed such that they permit a mechanical shifting of elements substantially in a horizontal plane and in the direction of the length of the under-springs of the seat. Thus the means for adjusting spring stiffness require but little space vertically and can be made as flat as possible.

In an additional advantageous embodiment of the invention, a manual, mechanical actuating device is provided for the means for the adjustment of spring stiffness. This has the advantage that the adjustment of the spring stiffness of the vehicle seat can be performed without unwieldy extras and electrical terminals. A mechanical actuating device, such as a pull cable operated by a knob or a lever is also extremely low in cost and not very liable to trouble. According to an alternative embodiment of the invention in this regard, an electronic system of operation is provided, as well as control of the automatic adjustment of spring stiffness for different persons and/or driving situations. Thus the spring stiffness adjustment can be performed automatically for example according to a setting of an automatic operating circuit (normal or sport), or adaptation to different persons and their body sizes or weights. This can be done similarly to the automatic changing of seat adjustments for various persons, as known in the automotive field, that is to say, by the mere pressing of a button, restoring the adjustments according to a memory of the user-specific settings. The electronic actuation of the means for adjusting the spring stiffness also has the advantage that the sometimes considerable forces required for the tightening of springs (increasing spring stiffness) do not have to be produced by means of complex reduction gearing.

According to another advantageous embodiment of the invention, the means for adjusting the spring stiffness in the seat cushion are coupled to sensing means for recording body data of a user or driver and an adaptive control of the underspring of the seat cushion is provided. The stiffness of the springs can thus automatically be optimally adjusted in each case after recording the body weight or body size or other body-related data, without the need for a user to bother about it.

According to another advantageous embodiment of the invention, the means for adjusting the stiffness of the springs of the seat cushion are coupled to a control of the motor vehicle for the automatic adaptation of the underspring to different driving situations and/or driving styles. The control can be, for example, a component of an on-board computer or other electronic motor or transmission control by means of which different driving styles and

situations can be detected, such as ASB, ESP, TCS and the like. For example, in sport driving in mountain country, the stiffness of the seat cushion of the driver's seat can thus advantageously be increased, as is usually the case with sport seats in passenger vehicles.

In an additional advantageous embodiment of the invention, the springs of the underside of the seat cushion consist of at least two leaf springs joined together, which are held loosely at one end and tightly at the other end, and whose effective spring length (its lever travel) is variable by means of a slider which is attached displaceably to the pair of leaf springs. The leaf springs have the advantage that they can be installed very flat, taking up little space, underneath the padding of the seat cushion, and their effective spring length, and thus their stiffness, can be adjusted in a very surprising way by means of the displaceable, block-like elements. The pair of leaf springs is joined permanently together, preferably in the middle, and the slide is preferably a block-like element enveloping the pair of springs, which is attached displaceably to the pair of springs.

In another advantageous embodiment of the invention, the springs of the underside of the seat are wire springs of a meandering shape, and one of the spring holders of the springs is displaeeable horizontally, lengthwise of the springs. The wire springs can thus be tightened or loosened by shifting one of the spring holders, which leads overall to increasing or reducing the stiffness of the springs. Of course, the other spring holder can also be made displaceable so that, by moving both spring holders away from one another, the spring wires fastened or held between them can be tightened to increase spring stiffness, for example after the spring force has diminished due to excessively long use of the seat or severe usage of the seat.

According to an additional advantageous embodiment of the invention in this regard, the springs are adjustable in stiffness by a spindle which is provided with an operating device and which is joined to one or both of the spring holders such that it can be shifted. A spindle for driving or actuating the adjustment of spring stiffness has the advantage that relatively great forces can be transmitted also in short steps, which permits a fine and simple adjustment of spring stiffness.

The springing according to the invention, for a seat in a motor vehicle according to the features of claim 11, has a plurality of mechanical springs which form an under-spring for the seat cushion, the springs being arranged substantially in a horizontal plane and are held

each at its extremities on a spring holder, means being provided for adjusting the stiffness of the springs. Also, conventional under-spring systems for seat cushions of passenger automobiles can be equipped with a system for adjusting spring stiffness. Simple, meander-shaped wire springs, such as are used conventionally in car seats, can nevertheless be varied in stiffness, i.e., in producible spring force, can be varied in their stiffness, i.e., their producible spring force, even after installation in the vehicle's seat, and for this reason any replacement of vehicle seats due to wear or a particular stiffness (sport seats) is unnecessary.

According to an embodiment of the invention that is advantageous in this regard, the springing is adapted so as to be integrated into an existing vehicle seat or seat cushion of a car seat. Thus even conventional vehicle seats which originally had no way of adjusting the stiffness of the seat can be equipped afterward with a system according to the invention for adjusting the spring stiffness.

Additional features, advantages and advantageous embodiments of the invention are to be found in the description that follows, in which the invention is described and explained in detail with the aid of embodiments represented in the drawing. In the drawing:

Figure 1 is a schematic perspective top plan view of a first embodiment of the springing of a motor vehicle seat according to the invention;

Figure 2 a schematic perspective top plan view of a second embodiment of the springing of a motor vehicle seat according to the invention with leaf springs;

Figure 3 a schematic perspective top plan view of a third embodiment of springing for a motor vehicle seat according to the invention with leaf springs and conventional wire springs, and

Figure 4 a schematic elevation of a fourth embodiment of a motor vehicle seat according to the invention, with coupling to a weight sensing system.

In Figure 1 part of a motor vehicle seat, namely the understructure or underspring 2 of the seat cushion 1 is represented schematically in a perspective top plan view. According to the invention, the underspring 2 of the seat cushion consists of a plurality of mechanical springs which in the embodiment here represented are three meander-shaped steel tension springs. The three springs 3 are provided within a frame or understructure of the seat cushion

1 underneath upholstery (not shown in the drawing) and a seat cover. The springs 3 are fastened between two spring holders 4 and 5. According to the invention at least one of the spring holders 4, 5 is displaceable in a horizontal plane lengthwise of the springs 3, so that the stiffness of the springs 3 can be adjusted, that is, the spring force can be increased or reduced. This is indicated in Figure 1 by the arrows on the front spring holder 4. The displaceability of the spring holder 4 on which one of the ends of each spring 3 is supported, can be achieved, for example, by fitting them into lateral grooves and providing a threaded spindle mechanism, or by any other means known to the person of the art for the displaceable arrangement of parts. By shifting the spring holder 4 leftward, the three springs 3 are tensed, so that the stiffness of the entire seating surface of the seat cushion is increased. In the opposite direction the stiffness of the springs is reduced. Of course, the number and shape of the springs of this embodiment are not restrictive of the invention, and also four, five or more springs can be provided, or a different kind of springs, such as leaf springs and spiral tension springs or the like, for example.

In Figure 2 a portion of an automobile seat is represented schematically according to a second embodiment of the invention. Unlike the previous embodiment, here a series of leaf spring packs are arranged side by side as undersprings 3. The underspring 2 here consists of springs 3 or spring packs which consist in each case of two leaf springs 11, 12, which are fixedly joined together in the center by a screw 13. The spring 3, consisting of an upper leaf spring 11 and a lower one 12, is mounted at its ends on a spring holder 4, 5, as in the previous embodiment; one of the mountings is affixed (to spring holder 4) and the opposite mounting is loose, i.e., able to slide (held on the spring holder 5). Two sliders 9 are provided on each of the springs 3, and are block-like elements which are arranged for displacement along the particular spring 3 or spring pack. The bottom leaf spring 12 of each spring pack is shorter than the upper leaf spring, so that the spring pack is fastened or borne on the upper leaf spring 11. By shifting the sliders 9 toward the middle of the particular spring 3 the effective spring length, that is, the leverage between the two support points of the holding elements 4 and 5, can be varied. In this way the stiffness of the spring is changed, so that by a mere shifting of the sliders 9, for example by an actuating means (not shown in the figure), a change in the stiffness of the underspring can be achieved.

In Figure 3 a third embodiment of the springing of a seat in a motor vehicle according to the invention is shown schematically in a perspective plan view . In this embodiment,

likewise conventional wire springs 3 are provided in the underspring 2 of the seat cushion of the car seat, as well as two adjusting springs consisting of leaf spring packs 11, 12, as they were described in connection with the embodiment according to Figure 2. The two leaf spring packs with sliders 9, arranged between the three conventional wire springs, permit, as described before, an adjustment of the spring stiffness by shifting the sliders 9 along the leaf springs 11, 12. The shifting in this case can be performed mechanically by an operating device (not shown in the drawing), such as a Bowden pull wire, or else by an electronic or hydraulic operation of the sliders 9.

In Figure 4 a fourth embodiment of a seat of a motor vehicle according to the invention is represented schematically , which is coupled to a weight sensor system and to a controller. The seat of the vehicle has a seat cushion 1 and a seat back 14, as well as a underspring 2 for the seat cushion, which is provided in a frame 10 underneath the seat cushion 1. The underspring 2 consists here, as in the two previous embodiments, of a series of leaf spring packs consisting of an upper 11 and a lower 12 leaf spring, which are bound together at the center by a screw 13, and which are provided in each case with two sliders 9 for adjusting the spring length. Moreover, in this embodiment an electronic actuating apparatus 16 is provided, by means of which the displacement of the slider 9 along the leaf spring pack 11 and 12 is possible. Thus the stiffness of the underspring 2 can be adjusted. In this embodiment there is furthermore a system 15 for determining or sensing the body weight of a user (active body control sensor) which can determine through a series of sensors 17 the body weight of the passenger. Depending on the value output from the sensor system 15, a control unit 8 is operated such that the stiffness of the underspring 2 is adjusted by the actuating apparatus 16 to an optimum level. Optimum, in this sense, means that the comfort of the seat cushion and its stiffness are automatically adapted to the body weight in question.

Alternatively, the springing of the seat cushion of a motor vehicle seat cushion can also be coupled with other control circuits of the motor vehicle, such as for example systems for monitoring and controlling performance in curves or in braking, or the like. This has the advantage that, depending on the particular running state of the vehicle, an optimally adjusted stiffness of the seat springing can be achieved.

All of the features set forth in the description, the claims and the drawing, may be essential to the invention, even in any desired combination with one another.